

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 December 2004 (29.12.2004)

PCT

(10) International Publication Number
WO 2004/112950 A2

(51) International Patent Classification⁷:

B01J

(21) International Application Number:

PCT/US2004/019589

(22) International Filing Date: 18 June 2004 (18.06.2004)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/480,132 20 June 2003 (20.06.2003) US

(71) Applicants (for all designated States except US):
DREXEL UNIVERSITY [US/US]; 32nd & Chestnut
Streets, Philadelphia, PA 19104 (US). CHEVRON U.S.A.,
INC. [US/US]; 6001 Bollinger Canyon Road, San Ramon,
CA 94583-2324 (US). THE BOARD OF TRUSTEES
OF THE UNIVERSITY OF ILLINOIS [US/US]; 352
Henry Administration Building, 506 Wright Street, Ur-
bana, IL 61801-3640 (US).

(72) Inventors; and

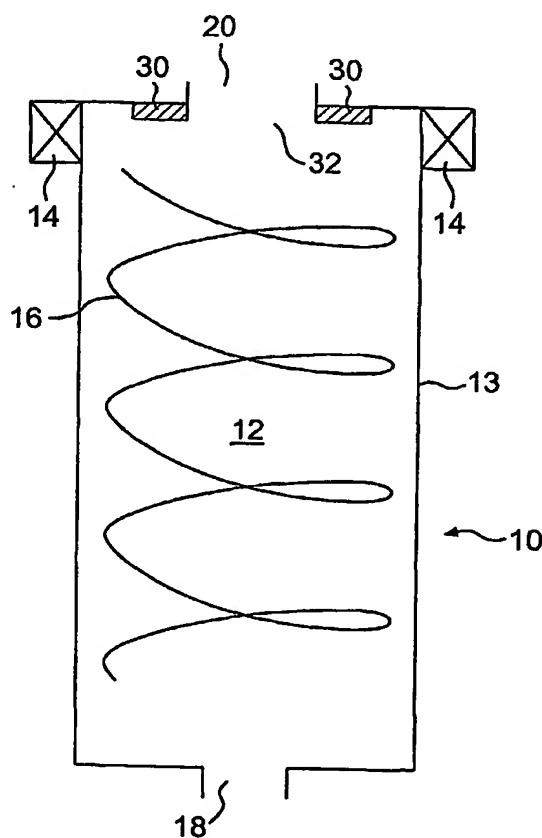
(75) Inventors/Applicants (for US only): GUTSOL, Alexander, F. [RU/US]; 203 Yorktown Court, Malvern, PA 19355 (US). FRIDMAN, Alexander [US/US]; 36 John James Audobon Way, Marlton, NJ 08053 (US). CHO, Young, I. [US/US]; 433 Tuvira Lane, Cherry Hill, NJ 08003 (US). KENNEDY, Lawrence [US/US]; 23406 West Turnberry Street, Naperville, IL 60564 (US). SAVELIEV, Alexel [BY/US]; 61 West 15th Street, Apt.211, Chicago, IL 60605 (US). RUFael, Tecle, S. [US/US]; 811 Robins Way, Stafford, TX 77477 (US). DESHPANDE, Vijay, A. [US/US]; 5313 Navarro, Houston, TX 77056 (US).

(74) Agent: DUNLEAVY, Kevin, J.; Knoble Yoshida & Dunleavy, LLC, Eight Penn Center, Suite 1350, 1628 John F. Kennedy Boulevard, Philadelphia, PA 19103 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,

[Continued on next page]

(54) Title: PLASMA REACTOR FOR THE PRODUCTION OF HYDROGEN-RICH GAS



(57) Abstract: A plasma reactor is provided. The plasma reactor includes a reaction chamber formed by a wall. Proximate to the first end of the reaction chamber, the plasma reactor includes a feed gas inlet for creating a reverse vortex gas flow in the reaction chamber. The plasma reactor also includes an anode and a cathode connected to a power source for generation of an electric arc for plasma generation in said reaction chamber. The plasma reactor may optionally include a movable electrode adapted for movement from a first, ignition position to a second, operational position in the reaction chamber. Also provided is a method of converting light hydrocarbons to hydrogen-rich gas, using the plasma reactor of the invention.



CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI,

SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 December 2004 (29.12.2004)

PCT

(10) International Publication Number
WO 2004/112950 A3

(51) International Patent Classification⁷: B01J 19/12,
C07C 1/00

OF THE UNIVERSITY OF ILLINOIS [US/US]; 352
Henry Administration Building, 506 Wright Street, Ur-
bana, IL 61801-3640 (US).

(21) International Application Number:

PCT/US2004/019589

(72) Inventors; and

(22) International Filing Date: 18 June 2004 (18.06.2004)

(75) Inventors/Applicants (for US only): GUTSOL, Alexander, F. [RU/US]; 203 Yorktown Court, Malvern, PA 19355 (US). FRIDMAN, Alexander [US/US]; 36 John James Audobon Way, Marlton, NJ 08053 (US). CHO, Young, I. [US/US]; 433 Tuvira Lane, Cherry Hill, NJ 08003 (US). KENNEDY, Lawrence [US/US]; 23406 West Turnberry Street, Naperville, IL 60564 (US). SAVELIEV, Alexei [BY/US]; 61 West 15th Street, Apt.211, Chicago, IL 60605 (US). RUIAEL, Tecle, S. [US/US]; 811 Robins Way, Stafford, TX 77477 (US). DESHPANDE, Vijay, A. [US/US]; 5313 Navarro, Houston, TX 77056 (US).

(25) Filing Language: English

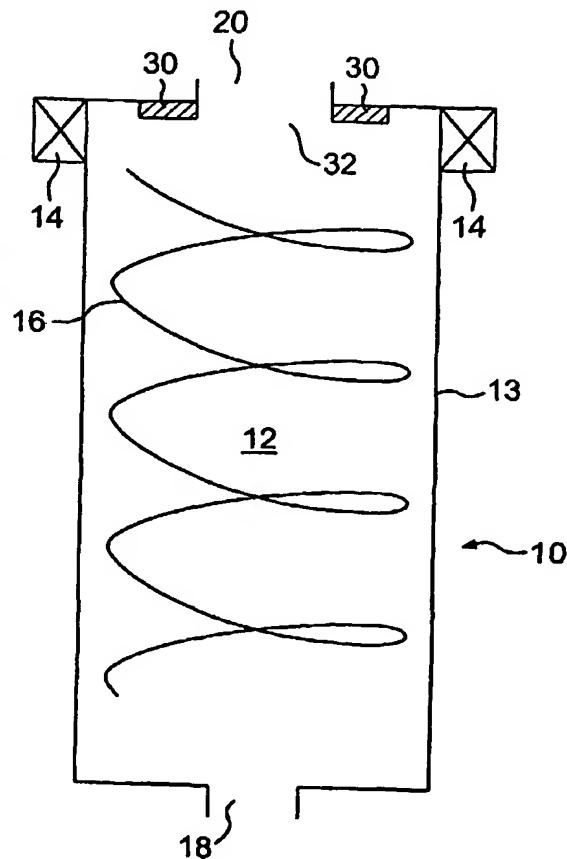
(26) Publication Language: English

(30) Priority Data:
60/480,132 20 June 2003 (20.06.2003) US

(74) Agent: DUNLEAVY, Kevin, J.; Knoble Yoshida & Dunleavy, LLC, Eight Penn Center, Suite 1350, 1628 John F. Kennedy Boulevard, Philadelphia, PA 19103 (US).

[Continued on next page]

(54) Title: PLASMA REACTOR FOR THE PRODUCTION OF HYDROGEN-RICH GAS



(57) Abstract: A plasma reactor (10) is provided. The plasma reactor (10) includes a reaction chamber (12) formed by a wall (13). Proximate to the first end of the reaction chamber, the plasma reactor includes a feed gas inlet (14) for creating a reverse vortex gas flow (16) in the reaction chamber. The plasma reactor (10) also includes an anode and a cathode connected to a power source for generation of an electric arc for plasma generation in said reaction chamber. The plasma reactor (10) may optionally include a movable electrode adapted for movement from a first, ignition position to a second, operational position in the reaction chamber. Also provided is a method of converting light hydrocarbons to hydrogen-rich gas, using the plasma reactor of the invention.



(81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *with international search report*

(88) **Date of publication of the international search report:**
6 May 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.